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Title:

SYSTEM AND METHOD FOR ROUTING CABLES

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SYSTEM AND METHOD FOR ROUTING CABLES

BACKGROUND

[0001] Electronic systems, such as computers, typically comprise many parts or components such as, hard drives, disk drives, compact disk read-only-memory (CD ROM) drives, digital versatile disc (DVD) drives, fans, and processors that are often grouped together inside of a shared enclosure. It is common for several cables to be routed between various components to provide communication paths and/or power to these various components. These data and utility cables can be bulky and may typically be difficult to accommodate within a single enclosure due to limited space.

[0002] Moreover, the existence of several cables within an electronic system often makes it difficult to route the cables in an effective manner. Multiple cables are usually bundled together in order to increase the organization of such cables. However, bundling may cause damage to the individual cables when the system causes a sharp transition among cables. A sharp transition typically occurs as cables are routed from one direction to another usually resulting in cables bundling on top of one another. Furthermore, after a cable has been added or replaced, the additional bulk of the newly added cables at the bending transition point adds difficulty to the replacement of access panels and other parts that were removed to access the cables.

[0003] Bundling also adds difficulty to the replacement or installation of cables because of the additional time used to sort out the various cables near, or within, the cable bundling. Some manufacturers install extra cables during the assembly process in order to avoid having to add or replace cables should a need arise in the future. However, this creates additional costs to consumers who purchase electronic systems that use only a minimum number of cables.

SUMMARY

[0004] One embodiment provides a cable routing system comprising a first channel for routing at least one of a plurality of cables in a first direction, a second channel for routing the cable in a second direction, and a plurality of teeth spaced apart from one another and disposed in one of the first channel and the second channel, the teeth positioned to create spaces

in-between the plurality of cables before the at least one cable transitions from the first direction to the second direction

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIGURE 1 is a diagram illustrating one embodiment of a cable routing mechanism;

[0006] FIGURE 1A is a diagram illustrating the minimum bend radius r of one cable;

[0007] FIGURE 2 is a diagram illustrating a view of FIGURE 1 with one channel removed;

[0008] FIGURE 3 is a diagram illustrating detail with respect to connecting cable routing teeth to a base;

[0009] FIGURE 4 is a flowchart illustrating an embodiment of a method for routing cables;

[0010] FIGURE 4A is a flowchart of another embodiment of a method for routing cables; and

[0011] FIGURE 5 is a diagram illustrating a view of FIGURE 1 with teeth present in both channels.

DETAILED DESCRIPTION

[0012] FIGURE 1 is a diagram illustrating one embodiment of cable routing mechanism 10. In one embodiment, cable routing mechanism 10 is used to increase the bend radius of cables 250 routed in electronics enclosure 300. Cable routing mechanism 10 includes a first channel 100 and a second channel 200. Channels 100 and 200 are connected to one another and positioned to create a right angle between the two channels. However, in alternative embodiments, channel 100 and channel 200 may be positioned to create any angle between the two channels.

[0013] Cable routing mechanism 10 is made of hot dipped galvanized steel according to some embodiments of the invention. Alternative embodiments utilize materials

such as plastics, composites, resins, aluminum alloys, ceramics, and/or the like in providing one or more of the components of cable routing mechanism 10. For example, a configuration according to one embodiment may utilize hot dipped galvanized steel for channels 100 and 200 while utilizing plastic resins for teeth 140. In addition, cable routing mechanism 10 of embodiments may be made of any material that complies with the electromagnetic interference (EMI) requirements and specifications of the enclosure or area where cable routing mechanism 10 is used. However, cable routing mechanism 10 of alternative embodiments may be comprised of materials providing no, or limited, EMI shielding.

[0014] Channel 100 includes a channel base 110, sides 120, and a plurality of teeth 140. Channel base 110 is a flat planar member that makes up the core of channel 100. However, base 110 may take a form other than a flat planar shape, and therefore be any one of a number of various shapes. For example, base 110 may be curved, trapezoidal, or rounded. Sides 120 project outward from base 110 and provide a lip for channel 100. Teeth 140 project outward from base 110. Channel 100 of the illustrated embodiment includes a cover, such as cover 150, that fits over channel base 110 and sides 120 that is operative to protect and cover various cables routed through channel 100.

[0015] Channel 200, illustrated in FIGURE 1, includes channel base 210 and channel sides 220. Base 210 is a flat planar member that makes up the core of channel 200. However, base 210 may take a form other than a flat planar shape and therefore be any one of a number of various shapes. For example, base 210 may be curved or rounded. Channel sides 220 project outward from channel base 210 and provide lips for channel 200.

[0016] Channel 200 of the illustrated embodiment includes a cover, such as cover 230. Cover 230 includes a cover base 235 and a flange section 236. Cover base 235 is a planar section, and flange section 236 extends outward from cover base 235 at an end of cover base 235, as shown in FIGURE 1. Flange section 236 of the illustrative embodiment lines up with one of sides 120 of channel 100 and helps to keep cables 250 in channel 200. However, channel 200 may be arranged such that cover 230 does not include flange section 236. Although cover 230 is illustrated without fastening devices for simplicity, cover 230 may be configured such that it includes fastening devices, such as clips, adhesives, screws, clips, hook and loops, brads, rivets, etcetera, used to secure cover 230 to channel 200. Cover 230 helps to conceal and protect cables that are routed through channel 200. Although FIGURE 1 shows channel 200 as

including one cover 230, channel 200 may include multiple covers. Covers used for channel 200 may take any one of a number of various cover configurations. For example, channel cover 230 may be opaque, clear, vented, or any combination thereof.

[0017] Similar to channel 200, channel 100 may include one or more covers to cover channel 100. As shown in FIGURE 2, cable routing mechanism 10 may be configured such that channel 100 includes multiple covers 150 and 155. Covers 150 and 155 operate to conceal and protect various types of cables that may be routed in channel 100. Channel 100 may be configured so that access to cables routed in channel 100 may be gained by removing both covers 150 and 155 or access may be gained by only removing one cover. Covers 150 and 155 may be configured in many ways. For example, covers 150 and 155 may be hinged together or may not be connected at all. Covers 150 and 155 may also be opaque, clear, vented, or any combination thereof. In addition, cover 150 may be configured in one manner and cover 155 may be configured in a different manner. For example, cover 150 may be opaque, while cover 155 is vented or clear.

[0018] When covers 150 and 155 are used, channel 100 may also include fastening devices 160 and 165. Fastening devices 160 are attached to covers 150 and 155 and fastening devices 165 are attached to base 110. Cover fastening devices 160 and base fastening devices 165 operate to attach and secure covers 150 and 155 to base 110 thereby facilitating covers 150 and 155 in securely covering channel base 110 and sides 120. However, in an alternative embodiment, channel 100 may be configured so that covers 150 and 155 operate to cover base 110 but do not cover sides 120. For example, covers 150 and 155 may include a clip that operates to clip covers 150 and 155 to sides 120 thereby covering base 110 and any cables inside but not covering sides 120. The fastening devices may include any type of fastening devices, such as clips, adhesives, screws, clips, hook and loops, brads, rivets, etcetera. For example, fastening device 160 may be a threaded screw, and fastening device 165 may be a mating counterpart to the threaded screw. Therefore, fastening device 160 may be screwed into fastening device 165 thereby securing covers 150 and 155 to base 110 to cover base 110 and sides 120. However, channel 100 of embodiments may be configured so that it does not include covers or fastening devices.

[0019] FIGURE 2 also illustrates channel 100 comprised of one complete and continuous unit or section and is therefore comprised of one base 110. However, in alternative

embodiments, channel 100 may be configured such that channel 100 is multi-sectional so that channel 100 may comprise two or more separate bases mounted next to each other. The different sections and thus the different bases may be provided in any one of a number of shapes. For example, a first section could take the form of a rectangle and a second section could be non-rectangular, such as a trapezoid.

[0020] Cable routing mechanism 10 of the illustrative embodiment further includes a plurality of teeth 140 aligned vertically in channel 100 as shown in FIGURES 1 and 2. However, cable routing mechanism 10 may be configured such that teeth 140 are aligned in different configurations. For example, teeth 140 may be aligned in a variety of configurations, such as diagonal, zigzag, curved, etcetera. Teeth 140 operate to increase the bend radius of cables as cables transition from one direction to another, as described further herein. Teeth 140 of the illustrative embodiment project straight out from base 110. However, channel 100 may be arranged such that teeth 140 may extend from base 110 at a different angle such as an upward or downward diagonal direction. In addition, teeth 140 are illustrated in FIGURES 1 and 2 as circular rods or pegs. Teeth 140 may take any shape, such as rectangular or triangular pegs. Teeth 140 are also illustrated comprising a uniform thickness, but in alternative embodiments, teeth 140 may be of varying thickness. For example, some teeth may be relatively thin and some teeth may be relatively thick.

[0021] Teeth 140 are also illustrated in FIGURES 1, and 2 as comprising a uniform length. However, teeth 140 may be of varying lengths, although the length of teeth 140 according to some embodiments will not prevent a channel cover, such as 155, from mounting flush to a channel base, such as 110.

[0022] Teeth 140 are also spaced apart from one another by an amount to accommodate cables and provide cable paths 146. Teeth 140 may be spaced evenly so that cable paths 146 are of the same width. However, in selected embodiments, teeth 140 may be spaced apart unevenly so that cable paths 146 are of varying widths. For example, in one embodiment, teeth 140 may be configured to allow a single cable to pass between each cable path 146, and in another embodiment, teeth 140 may be situated so that multiple cables can pass through each cable path 146.

[0023] In the embodiment illustrated in FIGURE 1, teeth 140 are located near the end proximal to channel 200 in order to provide spacing between cables transitioning between the horizontal routing of channel 100 and the vertical routing of channel 200 as well as to provide control of the cable bend radius. However, in alternative embodiments, teeth 140 may be located at varying positions in channel 100 or channel 200 depending on how cables will be routed through cable routing mechanism 10. For example, one effective placement of teeth 140 would be near the turn within a radius of a desired bend of the turn in order to achieve a maximum radius for the cables along the bend.

[0024] Teeth 140 may be mounted to channel base 110 in a variety of ways. Teeth 140 may be permanently attached to channel base 110 or may be attached so that teeth 140 may be added or removed to channel base 110 depending on various channel configurations. For example, teeth 140 may be pressed through the underside of channel base 110, welded to channel base 110, screwed into channel base 110, etcetera.

[0025] FIGURE 3 illustrates one technique for connecting teeth 140 to base 110. As shown in FIGURE 3, channel 100 may be adapted such that teeth 140 are mounted to teeth base 145 that is mounted to channel base 110. Teeth base 145 is a planar member that runs vertically across channel 100 in the embodiment illustrated in FIGURE 3. Although teeth base 145 is illustrated as extending along the entire channel base 110, cable routing channel 100 may be arranged such that teeth base 145 does not extend along the entire channel base 110. For example, teeth base 145 may be of varying sizes depending on the number of teeth mounted to teeth base 145 and the number of cables to be routed. Teeth base 145 may also be configured so that it can easily be removed from channel base 110 should a need arise. For example, teeth base 145 may be removed so that unused teeth could be removed or so that additional teeth could be added without having to remove the entire channel 100 from enclosure 300.

[0026] Channel 100 is shown in FIGURES 1 and 2 mounted to one wall 310 of enclosure 300. In this embodiment, wall 310 extends horizontally 311 and vertically 313 and enclosure top section 320 extends horizontally over channel 100. With respect to enclosure 300, channel 100 helps route cables in a horizontal direction and thus channel 100 may be referred to as a horizontal channel. Channel 200 is illustrated in FIGURE 1 as also mounted to wall 310 and extends horizontally and vertically. Channel 200 helps route cables in a vertical direction, and therefore, channel 200 may be referred to as a vertical channel. In an alternative embodiment,

cable routing mechanism 10 may be configured so that channels 100 and 200 are mounted to a frame or other structure located within enclosure 300. Cable routing mechanism 10 may also include a gasket mounted in-between wall 310 and channels 100 and 200. The gasket may be comprised of a material that complies with the electromagnetic interference (EMI) constraints and specifications of enclosure 300 so that the gasket is operative to minimize electromagnetic interference and not to interfere with any electronics inside of enclosure 300. The horizontal and vertical orientations used herein in the present embodiment are used to help explain one possible orientation. It should be understood that the embodiments described herein can be used in any orientation.

[0027] As illustrated in FIGURE 1, vertical channel 200 and horizontal channel 100 are positioned inside of enclosure 300 so that the two channels are perpendicular to one another. However, vertical channel 200 and horizontal channel 100 may be positioned so that a different angle is formed with respect to one another. For example, channel 100 may run diagonal and channel 200 may also run diagonal.

[0028] The angle that exists between horizontal channel 100 and vertical channel 200 determines the bend angle that cables will travel across when transitioning from one channel to another channel. Thus, the bend angle is the angle that exists between various channels or directions that cables will transition between when cables pass from one channel or direction to another channel or direction. The orthogonal relationship of channel 100 with respect to channel 200 in the illustrative embodiment causes their central longitudinal axes AA and BB to intersect at a right angle 240. Thus, cables 250 will transition through a right angle bend when passing from horizontal channel 100 to vertical channel 200. Horizontal channel 100 and vertical channel 200 are positioned next to one another so that a cable bend area 260 is created. Cable bend area 260 is the area of interface/ transition between channel 100 and channel 200. It is the area that the cables extend into after passing teeth 140 and, in this embodiment, channel connection seam 170. Connection seam 170 represents the location where, in one embodiment, edges of channel 100 and channel 200 are connected to one another. However, in alternative embodiments, channels 100 and 200 may be connected to one another at a different location. For example, a separate piece of material, such as a flat plate mounted to the back of both channels, may be used to connect the two channels together. In addition, various forms of connection may

be used to secure channel 100 to channel 200. Channels 100 and 200 may be welded together, screwed together, riveted together, notched together, etcetera.

[0029] Bend area 260 provides sufficient space to allow for cable bending after cables 250 transition through cable paths 146, as described in more detail herein. Bend area 260 may be of varying sizes depending on the type, size, and number of cables to be routed through channel 100 into channel 200.

[0030] Cables 250 are shown in FIGURE 1 as running through horizontal channel 100, into various cable paths 146, making a right angle bend in bend area 260, and then down into vertical channel 200. Teeth 140 operate to space cables 250 apart from one another before cables 250 transition through bend area 260 when moving from horizontal channel 100 into cable paths 146 and then into vertical channel 200. Spacing cables 250 apart from one another before cables 250 transition across right angle bend area 260 operates to increase the minimum bend radius of most cables 250 in bend area 260 over the bend radius they would have if bundled together. The minimum bend radius r of one cable 250 is illustrated in FIGURE 1A. The minimum bend radius is the radius of curvature at the tightest portion of the curve defined by a cable 250. As illustrated in FIGURE 1, channel 100 is wider than vertical channel 200 to provide extra space that helps to effectively space cables 250 apart from one another as cables 250 are routed into cable paths 246. However, channel 100 may be configured so that only a portion of channel 100 is wider than channel 200. As cables 250 are routed from one channel or position to another channel or position, cables 250 are spaced apart by passing through cable paths 146, in-between teeth 140, before entering into cable bend area 260.

[0031] The increased minimum bend radii of most cables helps prevent cables 250 from bundling along channel 100. Preventing the gathering and bundling of cables along channel 100 allows covers 150 and 155 to easily fit over channel base 110 and sides 120 and simplifies the task of removing or reinstalling channel covers 150 and 155 and any other components that were removed to access cables 250. As cables 250 travel down vertical channel 200, they retain some spacing which in turn will help prevent cables from bundling or gathering in one area in vertical channel 200. Cables 250 are thus spread out across the width of vertical channel 200. With cables 250 spread out in vertical channel 200, any vertical channel covers, such as cover 230, will easily fit over vertical channel base 210 and vertical channel sides 220 thereby simplifying the task of removing or reinstalling any vertical channel covers. Thus, cable

routing mechanism 10 will help to increase the minimum bend radii of most cables routed from one direction to another direction and allows a spaced, coplanar arrangement of the cables which ultimately helps save time that is often wasted on trying to sort out bundled cables.

[0032] FIGURE 4 illustrates an embodiment of a method of cable routing. The method comprises defining a first channel; defining a second channel; disposing a plurality of teeth in one of the first channel and the second channel, wherein the teeth are spaced apart from one another to create a plurality of cable paths; and running the cables in the first channel, through the cable paths, and into the second channel. FIGURE 4A is a flowchart illustrating another embodiment of a method of cable routing. In block 410, a first channel is defined. In block 420, a second channel is defined. In block 430, a plurality of teeth are disposed in one of the first channel and second channel whereby the teeth are spaced apart from one another creating cable paths. Normally, the cables will be run into the first channel, through the cable paths, and into the second channel as set forth in block 440. However, flow 400 may optionally include blocks 435 and 436 which follow block 430 and would return the flow to block 440. In block 435, the first channel and second channel are positioned near one another thereby creating an angle bend for the cables and a cable bend area thereby allowing the cables to maintain cable spacing as the cables transition from the first channel to the second channel. In block 436, the teeth are mounted in the first channel next to the angle bend.

[0033] However, the flow of FIGURE 4A may also be arranged to substitute blocks 445 and 446 for block 440 which would occur with optional blocks 435 and 436. In block 445, the cables run into the first channel; the cables are then assigned to a cable path; then, the cables will be threaded through the assigned cable paths; and subsequently, the cables will be run from the assigned cable paths into the angle bend. In block 446, the cables will be run from the angle bend into the second channel. In an alternative embodiment, flow 400 may be situated so that block 446 is replaced with block 447 that would follow block 445. In block 447, a plurality of teeth may be disposed in the second channel. The teeth are then mounted in the second channel near the angle bend. After the teeth are mounted in the second channel, the cables in the angle bend are assigned to at least one of the second channel cable paths, and then the cables are run from the angle bend through the assigned paths into the remainder of the second channel.

[0034] FIGURE 1 shows one set of teeth 140 mounted in horizontal channel 100 near right angle bend 240. However, an alternative configuration of cable routing mechanism 10 may include a plurality of teeth located throughout horizontal channel 100. In addition, FIGURE 1 illustrates vertical channel 200 without teeth 140. Yet, as illustrated in FIGURE 5, vertical channel 200 may include teeth 510 mounted inside of vertical channel 200, such as at the top of vertical channel 200 near right angle bend 240. Cable routing mechanism 10 is illustrated in FIGURE 5 with channel 200's cover 230 removed in order to show teeth 510. Teeth 510 operate to help space cables 250 apart from one another as cables 250 are routed through channel 200. Similar to teeth 140, teeth 510 are spaced apart so as to create cable paths 515 in-between teeth 510. As illustrated in FIGURE 5, teeth 510 extend across the width of channel 200 and are located near angle bend 240. Comparable to teeth 140, teeth 510 may be mounted to base 210 in a variety of ways. For example, teeth 510 may be pressed through the underside of channel base 210, welded to channel base 210, screwed into channel base 210, attached to some type of teeth base mounted to channel base 210, etcetera.

[0035] Teeth 510 may also be aligned in a variety of configurations, such as diagonal, zigzag, curved, etcetera. Teeth 510 may also extend from base 210 at a different angle such as an upward or downward diagonal direction. In addition, teeth 510 may take the form of any one of a number of various shapes. For example, teeth 510 may take the form of a rectangular or triangular peg. Although illustrated in FIGURE 5 as comprising a uniform thickness, teeth 510 may be of varying thickness. For example, some of teeth 510 may be relatively thin and some of teeth 510 may be relatively thick. The length of teeth 510 may vary. However, the length of teeth 510 will not prevent a channel cover, such as 230, from mounting flush to channel base 210. Although FIGURE 5 illustrates one set of teeth 510 mounted in channel 200, an alternative embodiment of cable routing mechanism 10 may include a plurality of teeth 510 mounted throughout vertical channel 200.

[0036] Although the foregoing examples have been made with reference to an enclosure, the concepts of the present invention may be applied to any of a number of cable routing situations. Cable routing mechanism 10 may be used to generally increase the minimum bend radius of most cables routed in any situation where cables are to be routed from one direction to another direction regardless of the location or angle existing between directions. This routing technique also tends to arrange the bend portions of the cables in a concentric

relationship with progressively greater minimum bend radii such that the cables may be positioned in a generally coplanar arrangement that prevents bundling and other associated problems. Moreover, although particular orientations have been referenced with respect to the exemplary embodiments to aid the reader in understanding the concepts of the present invention, these orientation references are merely for reference and cable routing mechanisms of various embodiments of the present invention may be configured in any desired orientation.